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AFOEHL REPORT 90-127EQ00098FEF

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FOR HEALTH & ENVIRONMENT

Source Emission Testing of Hospital Pathological Waste Incinerator K.I. Sawyer AFB MI

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July 1990

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Final Report

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AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
Brooks Air Force Base, Texas 78235-5501

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The 410 Strategic Hospital/SGPB requested source testing for particulate and visible emissions be conducted on the hospital Pathological Waste Incinerator. K.I. Sawyer AFB received a Notice of Violation from the Michigan Department of Natural Resources on the Pathological Waste Incinerator. Testing was accomplished on 28 Mar 90. The survey was conducted to determine if the incinerator will meet standards. Results indicate that the incinerator failed visible emission standards. A long term disposal method for pathological waste needs to be developed.

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Justification

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Illustrations

I. INTRODUCTION

On 28 Mar 90, source emission testing for particulate and visible emissions was conducted on the 410th Strategic Hospital pathological incinerator at K.I. Sawyer AFB by personnel from the Air Quality Function of the AF Occupational and Environmental Health Laboratory, Environmental Quality Division (AFOEHL/EQ). An air quality dispersion model was also run to determine a good engineering practice stack height. This survey was requested by the 410th Strategic Hospital Bioenvironmental Engineer to determine if the incinerator will meet state standards. Personnel involved with on-site testing are listed in Appendix A.

II. DISCUSSION

A. Background

The 410th Strategic Hospital was visited by the Environmental Compliance Assessment and Management Program (ECAMP) auditors in September 1989. It was noted that source emission testing had not been conducted on the hospital pathological waste incinerator. This survey was requested by the 410th Strategic Hospital Bioenvironmental Engineer to satisfy the ECAMP finding and determine if the incinerator will meet state standards. (Appendix B)

On 1 Feb 90, K.I. Sawyer AFB received a Notice of Violation from the Michigan Department of Natural Resources on the hospital pathological waste incinerator. The following violations were observed:

(1) emissions over 40% opacity

(2) limit switch inoperable

(3) door or seal warped

(4) Waste such as plastics were being incinerated (Permit was for type 4, 100% human/animal tissue only)

The mechanical problems discussed in the Notice of Violation were corrected prior to th AFOEHL team visit. Secondly, waste containing plastics was being handled by a contractor.

B. Site Description

The pathological waste incinerator is located in the medical logistics area of the hospital. The exhaust stack extends through the roof. A photograph of the exhaust stack is shown in Figure 1. The incinerator was manufactured by Advanced Combustion (Model CAI-100) and was designed for Type 4 waste (defined as 100% human/animal tissue). The unit does not have any air pollution control equipment and has the following operational parameters:

(1) two-chamber design

(2) propane fired

(3) 50 pounds per hour(lb/hr) load capacity

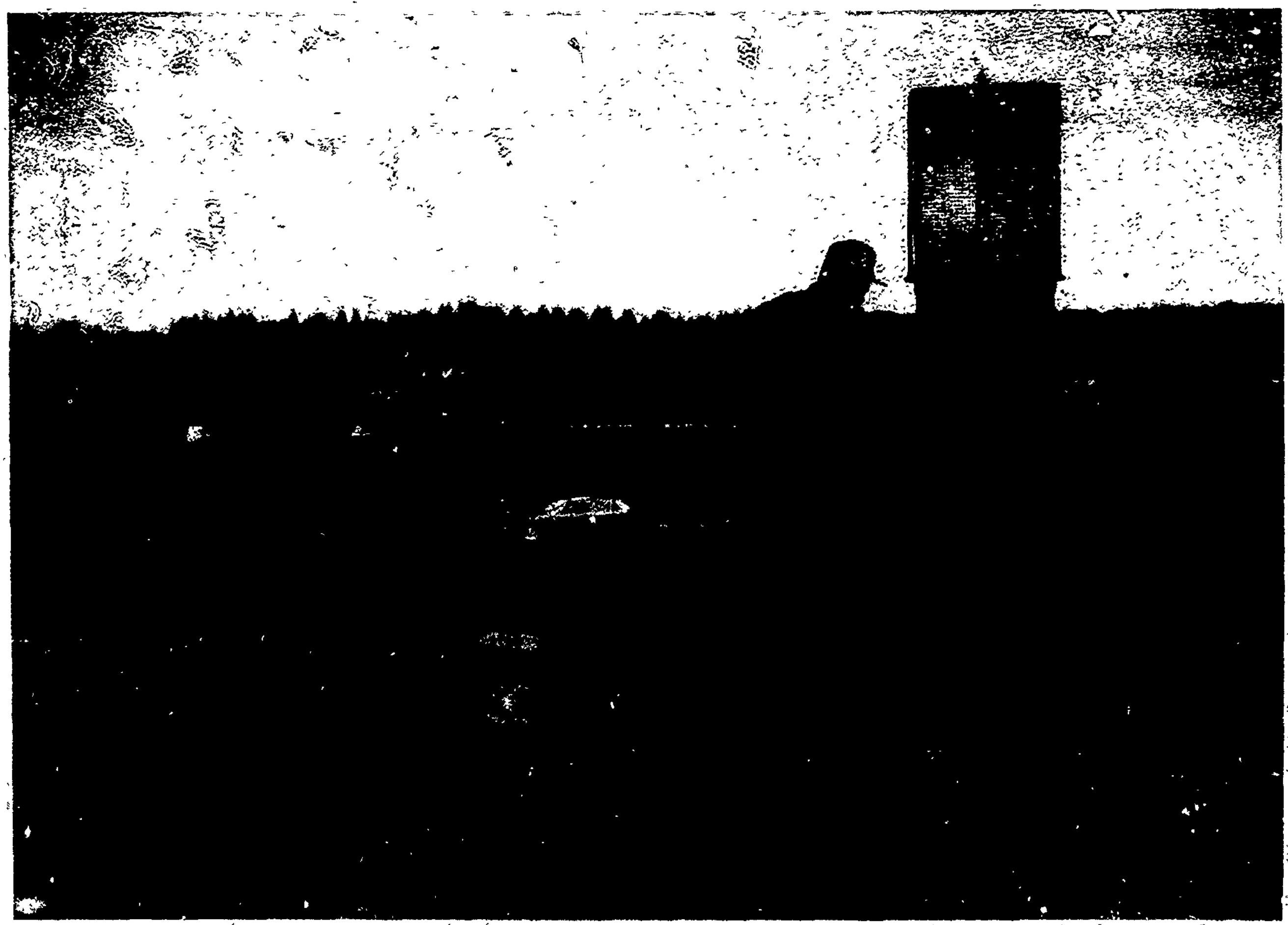

Figure 1. Pathological Waste Incinerator, K.I. Sawyer AFB MI

The incinerator is operated on a batch cycle at about 50 lb per burn. The burn time is about four hours. Approximately six batches of waste are burned per week.

C. Applicable Standards

Local standards applicable to incinerators used for disposal of pathological waste are defined under the State of Michigan Air Pollution Control Rules 301 and 331. These regulations, detailed in Appendix C, address two areas:

a. Rule 301 - Standards for density of emissions

Rule 301 prohibits visible emissions from a process or process equipment of a density greater than a 6-minute average of 20% opacity, except for one 6-minute average per hour of not more than 27% opacity.

b. Rule 331 - Emission of particulate matter

Rule 331 prohibits the emission of particulate matter in excess of 0.2 pounds per 1,000 pounds of exhaust gases corrected to 50% excess air.

D. Sampling Methods and Procedures

Present regulations require that all emissions testing be conducted in accordance with Appendix B to Title 40, Code of Federal Regulations, Part 60 (40 CFR 60). Therefore, sample train preparation, sampling and recovery, calculations and quality assurance were done in accordance with the methods and procedures outlined in 40 CFR 60, Appendix B.

Two sampling ports were installed at right angles in the stack. Two traverses of the stack cross-section were completed. These ports were installed approximately 1.5 duct diameters downstream and 9 duct diameters upstream from any flow disturbance. Based on the inside stack diameter, port location and type of sample (particulate), 16 traverse points (8 per diameter) were used to collect a representative particulate sample. Appendix D shows port locations and sampling points.

Prior to every sample run, cyclonic flow was determined by using the Type S pitot tube and measuring the stack gas rotational angle at each traverse point. Flow conditions were considered acceptable when the arithmetic average of the rotational angles was 20 degrees or less. A preliminary velocity pressure traverse was also accomplished at this time.

A grab sample for Orsat analysis (measures oxygen and carbon dioxide for stack gas molecular weight determination) was taken during each sample run. Orsat sampling and analysis equipment are shown in Figures 2 and 3. Flue gas moisture content, needed for determination of flue gas molecular weight determination, was obtained during particulate sampling.

Particulate samples were collected using the sampling train shown in Figure 4. The train consisted of a button-hook probe nozzle, heated inconel probe, heated glass filter, impingers and a pumping and metering device. The nozzle was sized prior to each sample run so that the gas stream could be sampled isokinetically (the velocity at the nozzle tip was the same as the stack gas velocity at each point sampled). Flue gas velocity pressure was measured at the nozzle tip using a Type S pitot tube connected to a 10-inch inclined-vertical manometer. Type K thermocouples were used to measure flue gas and sampling train temperatures. The probe liner was heated to minimize moisture condensation. The heated filter was used to collect particulates. The impinger train consisted of the following components:

a. first, third and fourth impingers: modified Greenburg-Smith type

b. second impinger: standard Greenburg-Smith design was used as a condenser to collect stack gas moisture. The pumping and metering system was used to control and monitor the sample gas flow rate. Equipment calibration data are found in Appendix E.

All calculations were made using the Environmental Protection Agency publication entitled "Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators", (EPA-340/1-85-013) and associated software programs. Particulate samples were analyzed according to the methods specified in Method 5.

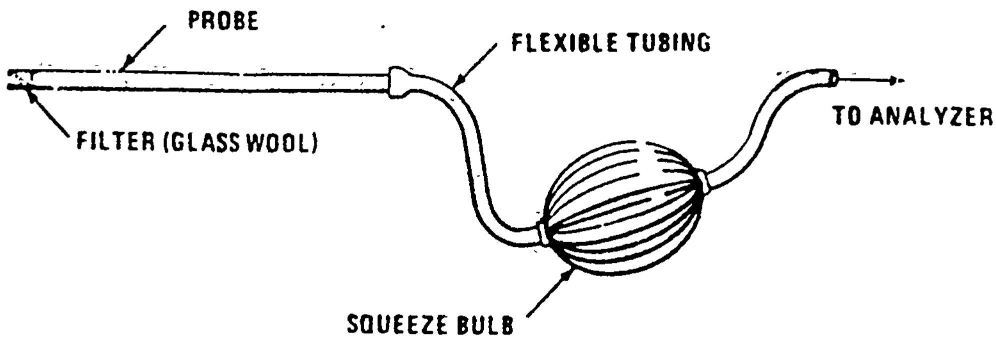

Figure 2. Grab Sampling Train

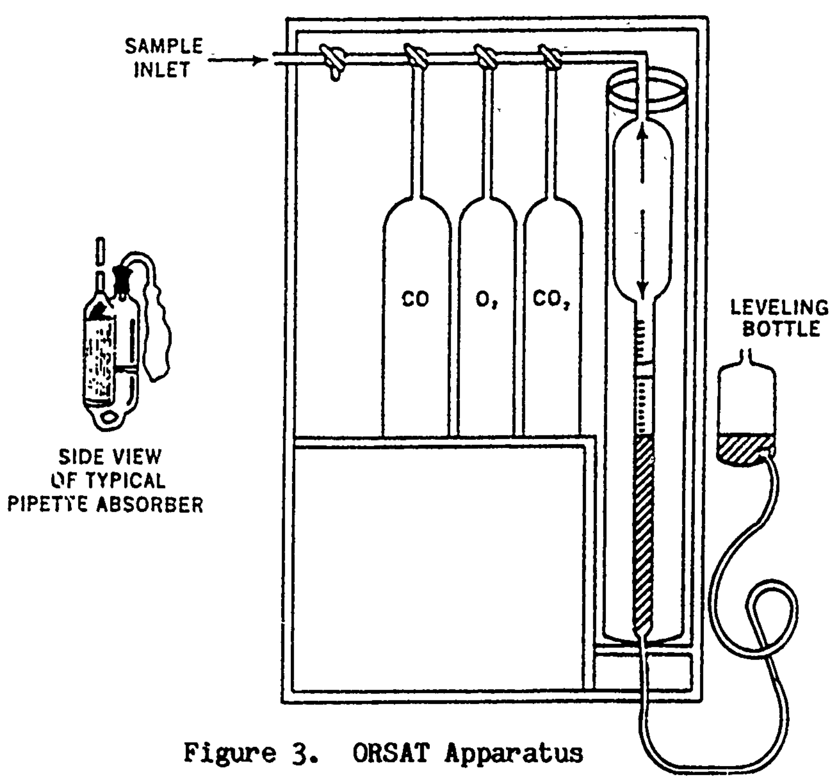

Figure 3. ORSAT Apparatus

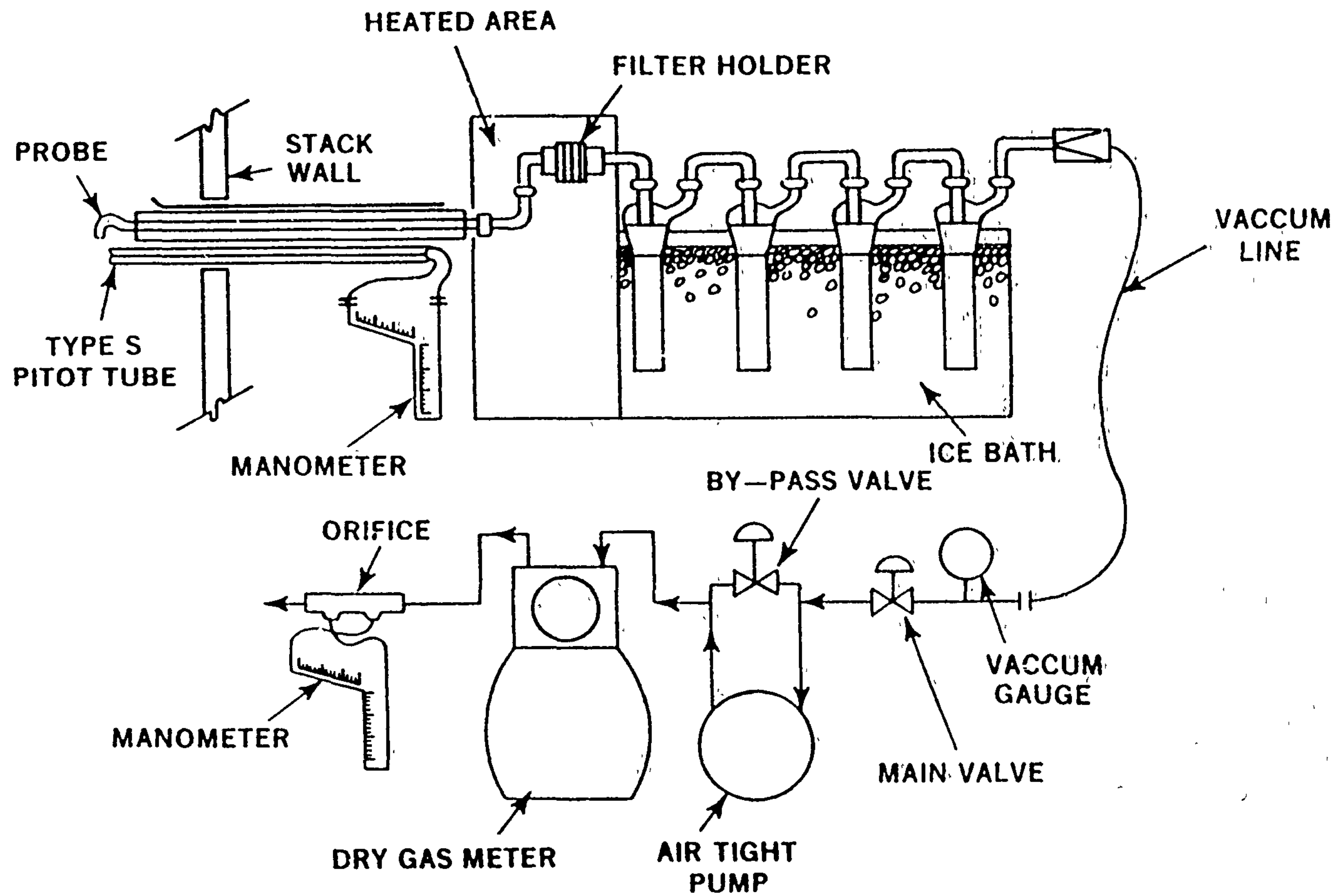

Figure 4. Particulate Sampling Train

E. Model Description

PTPLU-2.0 is an air quality dispersion model in version 6 of UNAMAP. It is a screening model designed to estimate the maximum short term concentration from a single point source as a function of atmospheric stability and wind speed. The model uses a Gaussian algorithm with options for gradual plume rise, bouyancy-induced dispersion, and stack downwash. Buoyancy-induced dispersion and stack downwash options are selected for these model runs. Maximum concentrations and their corresponding downwind distances are computed for two sets of wind speeds: winds constant with height and winds increasing with height. Pasquill-Gifford dispersion (rural) coefficients and stability classes are utilized. Short comings of the model, especially in this application, are fumigation and terrain effects neither of which are considered. Model results should be looked at in light of these two parameters.

F. Results

1. Visible Emissions

Visible emissions averaged greater than 40% opacity during run #2. This exceeds the emission limit of 20% opacity. Visible emissions during run #1 were less than 20% opacity. Testing was concluded after 2 runs since the incinerator could not meet the visible emission standards.

2. Particulate Emissions

The front half or filterable particulate matter (material collected on sampling train surfaces up to and including the filter) was determined for compliance purposes. Field data sheets are found in Appendix D and the resulting particulate emission calculations are presented in Appendix F. Table 1 provides the final particulate emissions test results. Particulate emissions averaged 0.075 lb/1,000 lb of exhaust gases corrected to 50% excess air. This complies with the applicable standards.

3. Dispersion Model

PTPLU was run with EPA recommended meteorological conditions and the model applied according to EPA options and guidelines. Under these guidelines, the mixing height is set at 1500 m, and the worst conditions under the applicable stability classes using extrapolated winds are then doubled or tripled to represent a worst case condition. Since PTPLU does not handle a low ceiling or fumigation scenario properly, the scenario used here better represents worst case ground level concentrations of pollutants. Table 2 gives the maximum ground level concentrations and the complete model run is in Appendix F. This table gives worst case concentrations and it's important to note the weather conditions where these concentrations would exist. These weather conditions exist mostly in the winter during strong inversions and winds calm to 15 mph, directed toward the roof air handler units.

Table 1. Particulate Emission Test Results

RUN	STACK GAS %CO_2	STACK GAS %O_2	TOTAL CATCH (mg)	EMISSIONS (lb/tlbeg)	EMISSIONS CORRECTED TO 50% EA (lb/tlbeg)
1	7.2	10.0	42.2	0.0422	0.0379
2	0.0	10.4	184.0	0.1663	0.1120
			AVG =	0.1043	0.075

Note: mg = milligrams
lb/tlbeg = pounds per thousand pounds of exhaust gases
EA = Excess Air

Table 2. Maximum Concentrations

Pollutant	Emission Rate (g/sec)	Max concentration at air handler height (mg/m^3)	Distance to Max Concentration (m)
Particulates	.0072	0.229	17

Note: g/sec = grams per second
mg/m^3 = milligrams per cubic meter
m = meter

The pollutant measured is particulate and has little chance to make it through the air handler inside the hospital. However, gaseous products (dioxins, furans, etc.) which were not measured could, at these same relative levels, pose serious health problems under certain meteorological conditions. A higher stack could eliminate these potential problems. This same model was run with various stack heights to determine a Good Engineering Practice (GEP) stack height. The GEP stack height should be 10 meters above the roof.

III. CONCLUSIONS

Compliance testing results indicate the incinerator is not in compliance with applicable State of Michigan emissions standards. The following problems were observed during operation of the incinerator:

1. Visible emissions were not in compliance. This is probably due to low primary and/or secondary chamber temperatures and inadequate loading procedures. Good engineering practices for pathological waste incinerators require:

   a. Primary chamber temperatures between 1400-1600^{o}F,

   b. Secondary chamber temperatures between 1800-2000^{o}F,

   c. Minimum residence time in the secondary chamber of 0.5 seconds.

The secondary chamber should be up to operating temperature (about 15 minutes) before the waste is loaded. Then the primary chamber is ignited.

2. There were no monitoring devices such as thermocouples for the primary and secondary chamber temperatures.

3. Cracks were found in the incinerator refractory.

The pathological waste incinerator will not meet the hospital's future needs. A long term disposal method for pathological waste needs to be developed. If a new incinerator is selected, it should be sited three thousand feet from the hospital and/or the nearest building. This will reduce the potential of toxics entering the hospital and other base facilities. Another alternative would be a new incinerator with Best Available Control Technology (BACT). Extending the present stack to 10 meters above the roof is not a viable solution.

IV. RECOMMENDATIONS

1. Allow the secondary chamber to heat up to operating temperature (at least 2000^{o}F) before the waste is loaded. The primary chamber can then be ignited.

2. The amount of waste per load needs to be reduced 50%. The number of batches per week can be increased to handle the volume of waste.

3. Install thermocouples on the primary and secondary chambers.

AFOEHL will remain active in supporting the base's present and future needs.

REFERENCES

1. Standards of Performance for New Stationary Sources, Title 40, Part 60, Code of Federal Regulations, July 1, 1984.

2. Quality Assurance Handbook for Air Pollution Measurement Systems - Volume III, Stationary Source Specific Methods, U.S. Environmental Protection Agency, EPA-600/4-77-027-b, Research Triangle Park, North Carolina, April 1977.

3. Source Test Calculations and Check Programs for Hewlett-Packard 41 Calculators, U.S. Environmental Protection Agency, EPA-340/1-85-018, Research Triangle Park, North Carolina, Sept 1985.

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APPENDIX A

Personnel Information

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1. AFOEHL TEST TEAM

Capt Paul Scott, Chief, Air Quality Function
Capt Ronald Vaughn, Consultant, Environmental Quality
1Lt Robert O'Brien, Consultant, Environmental Quality
Sgt Stanley Dabney, Technician, Environmental Quality

AFOEHL/EQE
Brooks AFB TX 78235-5501

Phone: AUTOVON 240-2891
Commercial (512) 536-2891

2. K.I. Sawyer on-site representatives

Capt Gregory Zigulis MSgt James Siler	410 Strat Hosp/SGPB 410 Strat Hosp/SGPB AV 472-2942 COM (906) 346-2942
1Lt Jerry Arends Mr Mike Nutini	410 Strat Hosp/SGAL 410 Strat Hosp/SGAL AV 472-2239 COM (906) 346-2239

3. State of Michigan representative

Warren Dellies	1990 U.S. 41 South Marquette, MI 49855 COM (906) 228-6561

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Appendix B

Request Letter

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EH Rec'd 21 Nov 89
action

DEPARTMENT OF THE AIR FORCE
410TH STRATEGIC HOSPITAL (SAC)
K I SAWYER AIR FORCE BASE, MICHIGAN 49843-5300

REPLY TO ATTN. OF: SGPB

9 October 1989

SUBJECT: Hospital Incinerator Emmission Testing

TO: SG 1300
HQ SAC/SGPB 9 Nov 89
AFOEHL/CC 17 NOV 1989
AFOEHL/EQU
IN TURN

1. The 410th Strategic Hospital was audited by the Environmental Compliance Assessment and Management Program (ECAMP) auditors in September 1989. ECAMP auditors felt that the hospital incinerator should have emission testing performed. The ECAMP finding is at Atch 1.

2. After discussions with the regulating agency (Michigan Department of Natural Resources) particulate testing is not required for permit compliance. However, we feel that emissions testing for this 32 year old incinerator would be a good idea.

3. We request that a AFOEHL/EQU team conduct emissions testing on our hospital incinerator at its earliest opportunity, to ensure permit parameters for emissions are being met. Permit conditions are at Atch 2. Capt Scott of AFOEHL/EQU states that AFOEHL/EQU testing typically consists of analyzing for particulates, opacity, and chlorides; such testing would adequately assess our compliance.

4. Incinerator classification and usage data is at Atch 3.

5. Please call me at autovon 472-2942 if there are any questions pertaining to this request.

GREGORY G. ZIGULIS, Capt, USAF, BSC
Chief, Bioenvironmental Engineering Services

3 Atchs
1. ECAMP Findings
2. Permit
3. Incinerator Details

Peace . . . . is our Profession

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APPENDIX C

State Regulations

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R 336.1283. Permit system exemptions; testing and inspection equipment.

Rule 283. The permit system does not apply to any of the following:

(a) Laboratory equipment used exclusively for chemical or physical analysis or experimentation, except equipment used for controlling radioactive air contaminants.

(b) Equipment used for hydraulic or hydrostatic testing.

(c) Equipment for inspection of metal products.

R 336.1284. Permit system exemptions; containers.

Rule 284. The permit system does not apply to containers, reservoirs, or tanks used exclusively for any of the following:

(a) Dipping operations for coating objects with oils, waxes, greases, or natural or synthetic resins containing no organic solvents.

(b) Electrolytic plating with, electrolytic polishing of, or electrolytic stripping of, the following metals: brass, bronze, cadmium, copper, iron, lead, nickel, tin, zinc, and precious metals.

(c) Storage of butane, propane, or liquefied petroleum gas in a vessel with a capacity of less than 40,000 gallons.

(d) Storage of lubricating oils.

(e) Storage of no. 1 to no. 6 fuel oil as specified in ASTM-D-396-69, gas turbine fuel oils nos. 2-GT to 4-GT as specified in ASTM-D-2880-71, or diesel fuel oils nos. 2-D and 4-D as specified in ASTM-D-975-68. These ASTM methods are herein adopted by reference. Copies may be inspected at the Lansing office of the air quality division of the department of natural resources. Copies may be obtained from the Department of Natural Resources, P.O. Box 30028, Lansing, Michigan 48909, at a cost of $4.00 each. Copies may also be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, at a cost of $4.00 each.

(f) Storage of sweet crude or sweet condensate in a vessel with a capacity of less than 40,000 gallons.

(g) Storage of sour crude or sour condensate in a vessel with a capacity of less than 40,000 gallons if vapor recovery or its equivalent is used to prevent the emission of vapors to the atmosphere.

(h) Gasoline storage and handling equipment at loading facilities handling less than 20,000 gallons per day or at dispensing facilities.

R 336.1285. Permit system exemptions; miscellaneous.

Rule 285. The permit system does not apply to any of the following:

(a) Maintenance structural changes, parts replacement, repairs considered by the commission to be minor, or relocation of equipment within the same building not involving any change in the quality, nature, or quantity of the emission of an air contaminant therefrom. Examples of minor parts replacement or repairs include the following:

(i) Replacing bags in a baghouse.

(ii) Replacing wires, plates, rappers, or electric circuitry in an electrostatic precipitator which does not measurably alter the design efficiency of the unit.

(iii) Replacement of fans, pumps, or motors which does not alter the operation of a source of performance of a control device.

(iv) Boiler tubes.

(v) Piping and ductwork.

(vi) Replacement of engines, compressors, or turbines as part of a normal maintenance program.

(b) Equipment used for any mode of transportation.

(c) Internal combustion engines with less than 10,000,000 Btu/hour maximum heat input.

(d) Vacuum pumps in laboratory or pilot plant operations.

(e) Portable brazing, soldering, or welding equipment.

(f) Grain, metal, or mineral extrusion presses.

(g) The following equipment and an exhaust system or collector exclusively serving the equipment:

(i) Drop hammers or hydraulic presses for forging or metalworking.

(ii) Die casting machines.

(iii) Equipment for surface preparation of metals by use of aqueous solutions, except for acid solutions.

(iv) Atmosphere generators used in connection with metal heat treating processes.

(v) Equipment used exclusively for sintering of glass or metals, but not exempting equipment used for sintering metal-bearing ores, metal scale, clay, flyash, or metal compounds.

(vi) Equipment for brazing, welding, soldering, carving, cutting, routing, turning, drilling, machining, sawing, surface grinding, sanding, planing, buffing, or polishing ceramic artwork, leather, metals, plastics, rubber, wood, or wood products on a nonproduction basis.

(vii) Photographic process equipment by which an image is reproduced upon material sensitized to radiant energy.

(viii) Battery charging operations.

(h) Lagoons and sewage treatment plant facilites, excluding lime storage equipment, sewate sludge incinerators, and heat treatment processes.

(i) Livestock and livestock handling systems from which the only potential air contaminant emission is odorous gas.

(j) Equipment for handling and drying grain on a farm.

(k) Equipment used for oil and gas well drilling, testing, completion, and workover activities.

(l) Portable steam deicers that have a heat input of less than 1,000,000 Btu's per hour.

PART 3. EMISSION LIMITATIONS AND PROHIBITIONS — PARTICULATE MATTER

R 336.1301. Standards for density of emissions.

Rule 301. (1) Except as provided in subrules (2), (3), and (4) of this rule, a person shall not cause or permit to be discharged into the outer air from a process or process equipment a visible emission of a density greater than the most stringent of the following:

(a) A 6-minute average of 20% opacity, except for 1 6-minute average per hour of not more than 27% opacity.

(b) A limit specified by an applicable federal new source performance standard.

(c) A limit specified as a condition of a permit to install or permit to operate.

(2) The provisions of this rule shall not apply to any process or process equipment for which fugitive visible emission limitations are specified in any other administrative rule of the commission.

(3) The provisions of subrule (1) of this rule shall not apply to visible emissions due to uncombined water vapor.

(4) Upon request by the owner of a process or process equipment for which an allowable particulate emission rate is established by R 336.1331, the commission

may establish an alternate opacity. Such alternate opacity shall not be established by the commission unless the commission is reasonably convinced of all of the following:

(a) That the process or process equipment subject to the alternate opacity is in compliance or on a legally enforceable schedule of compliance with the other rules of the commission.

(b) That compliance with the provisions of subrule (1) of this rule is not technically or economically reasonable.

(c) That reasonable measures to reduce opacity have been implemented or will be implemented in accordance with a schedule approved by the commission.

R 336.1302 [Rescinded]

R 336.1303 Grading visible emissions.

Rule 303. The opacity of a visible emission shall be determined by a qualified observer and shall be certified in accordance with, and using the procedures specified in, reference method 9 or an alternative method approved by the commission.

R 336.1304 through R 336.1309.
[Reserved]

R 336.1310. Open burning.

Rule 310. (1) A person shall not cause or permit open burning of refuse, garbage, or any other waste materials, except for the burning of the following:

(a) Waste disposal of material from and at 1- or 2-family dwellings where the burning does not violate any other commission rules.

(b) Structures and other materials used exclusively for fire prevention training if prior approval is obtained from the commission.

(c) Trees, logs, brush, and stumps in accordance with applicable state and local regulations if the burning is not conducted within a priority I area as listed in table 33, a priority II area as listed in table 34, nor closer than 1400 feet to an incorporated city or village limit and the burning does not violate any other commission rules.

(d) Beekeeping equipment and products, including frames, hive bodies, hive covers, combs, wax, and honey when burned for bee disease control.

(e) Logs, brush, charcoal, and similar materials for the purpose of food preparation or recreation.

(2) These exceptions do not authorize open burning where prohibited by local law or regulation.

R 336.1311 through R 336.1319.
[Reserved]

R 336.1320 Compliance programs.

Rule 320. (1) A person responsible for the operation of any existing process or process equipment subject to the provisions of R 336.1331, table 31, items A.3, A.4, B.5, G.2, I, and J shall submit to the commission, by January 18, 1981, a written program, acceptable to the commission, for compliance with such rule or evidence of compliance with such rule. Such evidence shall include available emission data, material balance calculations, control equipment specifications, or other information that demonstrates compliance.

(2) The program required by subrule (1) of this rule shall include the method by which compliance with such rule shall be achieved, a description of new equipment to be installed or modifications to existing equipment to be made, and a timetable which specifies, at a minimum, the following dates:

(a) The date equipment shall be ordered.

(b) The date construction or modification of equipment shall begin.

(c) The date initial start-up of equipment shall begin.

(d) The date final compliance shall be achieved, if not the same as the date specified in subdivision (c) of this subrule.

R 336.1321 through R 336.1329.
[Reserved]

R 336.1330 Electrostatic precipitator control systems.

Rule 330. (1) After July 1, 1980, it shall be unlawful to operate any cement kiln, kraft recovery boiler, lime kiln, calciner, pulverized coal-fired boiler, basic oxygen furnace, or gypsum dryer controlled by an electrostatic precipitator control system unless each transformer-rectifier set of the electrostatic precipitator is equipped with a saturable core reactor, silicon-controlled rectifier linear reactor, or equivalent type automatic control system approved by the commission. Except for very large precipitators, each automatic controller shall be set to provide maximum power, or optimal power if operating in a sparking mode, from its respective transformer-rectifier set.

(2) Each transformer-rectifier set subject to the provisions of subrule (1) shall be capable of operating in a spark-limited mode and shall meter and display the primary RMS voltage and amperage, the average secondary amperage, and the average spark rate. The requirement to meter and display the average spark rate shall not apply if the automatic controller employs solid state circuitry to preset power levels based on sparking rate limits.

(3) The commission shall waive the requirements of subrule (2) of this rule if both of the following conditions are met:

(a) A satisfactory demonstration is made that the precipitator is capable of providing for compliance with all applicable particulate emission and opacity limits.

(b) The precipitator existed before July 1, 1979, or was covered by an application for a permit to install received by the commission before July 1, 1979.

R 336.1331 Emission of particulate matter.

Rule 331. (1) It is unlawful for a person to cause or allow the emission of particulate matter from any process or process equipment in excess of any of the following limits:

(a) The maximum allowable emission rate listed in table 31.

(b) The maximum allowable emission rate listed by the commission on its own initiative or by application. A new listed value shall be based upon the control results achievable with the application of the best technically feasible, practical equipment available. This applies only to processes and process equipment not assigned a specific emission limit in table 31.

(c) The maximum allowable emission rate specified as a condition of a permit to install or a permit to operate.

(d) The maximum allowable emission rate specified in a voluntary agreement, performance contract, stipulation, or an order of the commission.

(e) The maximum allowable emission rate as determined by table 32 for processes and process equipment not covered in subdivisions (a) to (d) of this subrule.

(2) Compliance with any emission limit required by this rule shall be determined by using the corresponding reference test method specified in table 31 or the reference test method deemed appropriate by the commission for processes or process equipment not listed in table 31.

(3) Tables 31, 32, 33, 34, and figure 31 read as follows:

TABLE 31 (continued)

Process or process equipment	Capacity rating for each unit	Maximum allowable emission at operating conditions[1] (lbs. particulate/1,000 lbs. gas except as noted)	Applicable reference test method
5. Other modes of firing coal (new processes or process equipment[6])	All sizes	0.10	5B or 5C
6. Wood (sawdust, shavings, hogged, other) where heat input of wood fuel greater than 75% of total heat input.		0.50	5B or 5C
All other combination fuel-burning equipment that uses wood as 1 of the fuels.		Apply to commission for specific emission limit.	
7. Combination fuel-firing or combination fuel/waste-firing (new process or process equipment)	All sizes	Apply to commission for specific emission limit.	5B or 5C
	Rating in pounds waste per hour		
B. Incinerators			
1. Residential apartments, commercial and industrial[3,4]	0-100	0.65	5B or 5C
	Over 100	0.30	5B or 5C
2. Municipal	All	0.30	5B or 5C
3. Pathological[4]		0.20	5B or 5C
4. Manure drying or incineration[4]		0.20	5B or 5C
5. Liquid waste incinerator		0.10 compliance shall be achieved as expeditiously as practical, but not later than December 31, 1982.	5B or 5C
6. Sewage sludge incinerator		0.20 compliance shall be achieved as expeditiously as practical, but not later than December 31, 1982.	5B or 5C

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APPENDIX D

Field Data

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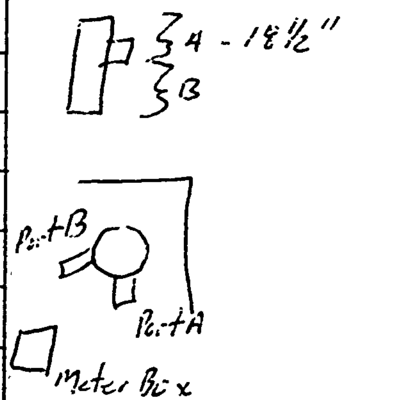
PARTICULATE SAMPLING DATA SHEET

Y_i = 0.997 ΔH@ = 1.969

RUN NUMBER	R 1
DATE	28 Mar 70
PLANT	Hosp Incinerator
BASE	KI Sawyer
SAMPLE BOX NUMBER	
METER BOX NUMBER	Vatech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$ 1205 HRS

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

Pitot check Pre - Okay

Probe @ 17" - Okay

Pitot check Post -

Probe @ 22 in Hg - Okay

AMBIENT TEMP (°F)	
STATION PRESS (in Hg)	27.85
HEATER BOX TEMP (°F)	
PROBE HEATER SETTING	
PROBE LENGTH (in)	
NOZZLE AREA (A) (sq ft)	
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC STATIC PRESSURE (in H20)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Port A 1	5		172		.03	1.53	158.75	42		42		
2	10	5	370		.07	3.05		43		43	264	35
3	15		428		.07	2.55		48		43	270	38
4	20	12	803		.08	2.05		48		44	261	38
5	25		760		.07	2.06		49		44	257	38
6	30	2	1060		.08	1.71		52		44	260	40
7	35		1037		.08	1.74		50		45	258	37
8	40	3	1056		.08	1.71		46		45	258	38
							173.2					
Port B 1	45		456		.07	2.46		47		45	258	38
2	50	7	464		.07	2.48		56		47	264	40
3	55	9	443		.07	2.55		60		48	260	43
4	60		877		.06	1.48		63		50	263	48
5	65	7	1118		.08	1.66		53		49	256	43
6	70	7	1040		.08	1.75		55		49	263	42
7	75	7	966		.06	1.82		60		51	271	46
8	80	14	947		.08	1.88		62		51	269	49
							203.2					
									49			
		$\overline{T_s}$ =	758		ΔH	2.03						
							√TsTs =	7.3728				

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
K.I Sawyer	28 Mar 90	# 1

BUILDING NUMBER	SOURCE NUMBER

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2991	.2922	.0069
ACETONE WASHINGS *(Probe, Front Half Filter)*	98.7048	98.6685	.0353
BACK HALF *(If needed)*			
	Total Weight of Particulates Collected		.0422 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	212	200	12
IMPINGER 2 *(H20)*	216	200	16
IMPINGER 3 *(Dry)*	1.6	0	1.6
IMPINGER 4 *(Silica Gel)*	213.2	200	13.2
	Total Weight of Water Collected		42.8 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	0	0	0		0
VOL % O_2	20.2	20.4	20.4		20.3
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

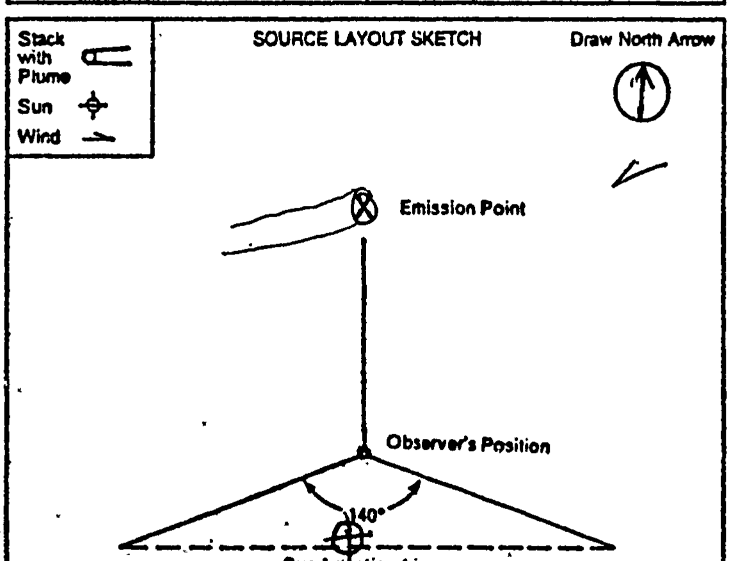
AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

VISIBLE EMISSION OBSERVATION FORM

No. ONE

COMPANY NAME	KI Sawyer AFB
STREET ADDRESS	Hospital
CITY	KI Sawyer AFB
STATE	Mich
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	Hospital Incinerator
PROCESS EQUIPMENT	Incinerator
OPERATING MODE	nominal
CONTROL EQUIPMENT	none
OPERATING MODE	N/A
DESCRIBE EMISSION POINT	Stack @ spark arrestor
HEIGHT ABOVE GROUND LEVEL	18'
HEIGHT RELATIVE TO OBSERVER	Start 18' End
DISTANCE FROM OBSERVER	Start 60' End ✓
DIRECTION FROM OBSERVER	Start N End ✓
DESCRIBE EMISSIONS	Start N/A End
EMISSION COLOR	Start N/A End
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start 2' End 2'
DESCRIBE PLUME BACKGROUND	Start Sky End Sky
BACKGROUND COLOR	Start White Gray End ✓
SKY CONDITIONS	Start OVC End OVC
WIND SPEED	Start <05 End ✓
WIND DIRECTION	Start 090 End ✓
AMBIENT TEMP	Start 41 End ✓
WET BULB TEMP	
RH, percent	50

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
28 March 90	1224	1231

MIN \ SEC	0	15	30	45	COMMENTS
1	Ø	Ø	Ø	Ø	
2	Ø	Ø	Ø	Ø	
3	Ø	Ø	Ø	Ø	
4	Ø	Ø	Ø	Ø	
5	Ø	Ø	Ø	Ø	
6	Ø	Ø	Ø	Ø	
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	Paul T. Scott
OBSERVER'S SIGNATURE	Paul T Scott
DATE	28 March 90
ORGANIZATION	AFOEHL/EQE
CERTIFIED BY	TACB (Texas Air Control Board)
DATE	16 March 90

$Y_i = .999$ $\Delta H_@ = 1.769$

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2

DATE: 28 Mar 90

PLANT: Hosp Incinerator

BASE: KI Sawyer

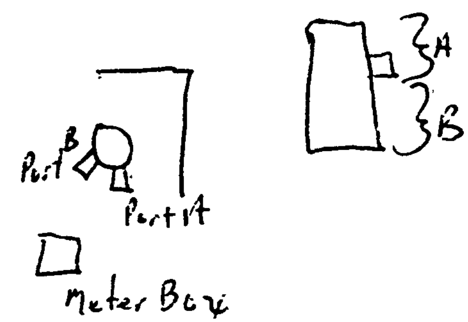
SAMPLE BOX NUMBER:

METER BOX NUMBER: Nutech 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

Pitot Check Pre - okay

Probe - okay

Pitot Check Post

Probe @ 22" Hg - okay

AMBIENT TEMP: °F

STATION PRESS: 29.85 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: 6 ft in

NOZZLE AREA (A): .15003 sq ft

Cp: .84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	~~VAC~~ STATIC PRESSURE (in H20)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Port B 1	~~5~~ 4	7	400		.06	2.27	204.995	49		49	265	40
2	~~10~~ 8	7	430		.06	2.21		56		49	260	36
3	~~15~~ 12	9	430		.06	2.22		60		50	259	37
4	~~20~~ 16	10	838		.06	1.53		62		51	257	39
5	~~25~~ 20	15	1039		.06	1.77		63		52	257	42
6	~~30~~ 24	15	1067		.08	1.81		64		53	258	44
7	~~35~~ 28	15	996		.08	1.83		64		54	258	46
8	~~40~~ 32	15	936		.08	1.91		64		55	263	53
Port A 1	~~45~~ 36	17	582		.06	1.92		64		56	263	59
2	~~50~~ 40	17	519		.06	2.04		63		56	264	60
3	~~55~~ 44	20	477		.06	2.13		63		57	263	63
4	~~60~~ 48	20	812		.06	1.57		63		57	265	61
5	~~65~~ 52	19	1092		.08	1.72		63		57	264	63
6	~~70~~ 56	19	1044		.08	1.77		63		57	264	64
7	~~75~~ 60	19	966		.08	1.87		63		58	266	65
8	~~80~~ 64	20	937		.08	1.91		63		57	264	65
							254.267	T_m	58			
			T_s = 782			ΔH = 1.90						
					$\sqrt{\Delta P} \cdot \sqrt{T_s}$ = 9.3086							

OEHL FORM 18 MAY 78

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
K.I Sawyer	28 Mar 90	2

BUILDING NUMBER	SOURCE NUMBER

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.3741	.2903	.0838
ACETONE WASHINGS *(Probe, Front Half Filter)*	~~.3~~ 105.0596	104.9581	.1002
BACK HALF *(If needed)*			
	Total Weight of Particulates Collected		.1840 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	210	200	10
IMPINGER 2 *(H20)*	220	200	20
IMPINGER 3 *(Dry)*	10.1	0	10.1
IMPINGER 4 *(Silica Gel)*	221	200	21
	Total Weight of Water Collected		61.1 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.6	7.8	7.8		7.7
VOL % O_2	10.4	10.2	10.5		10.4
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

VISIBLE EMISSION OBSERVATION FORM

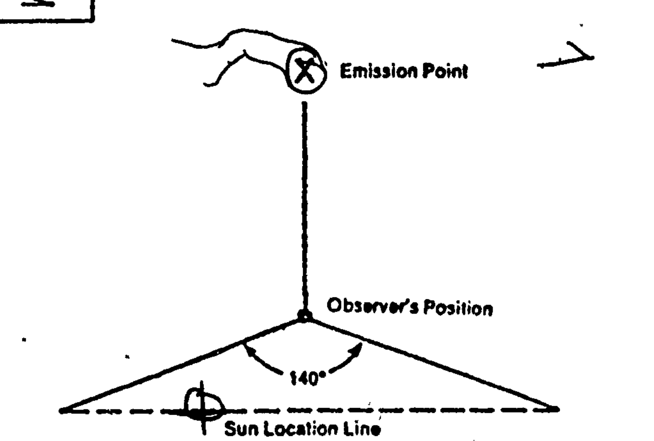
No. Two

COMPANY NAME	KI SAWYER
STREET ADDRESS	Hospital
CITY	KI Sawyer
STATE	MI
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	Incinerator
PROCESS EQUIPMENT	Incinerator
OPERATING MODE	
CONTROL EQUIPMENT	none
OPERATING MODE	nominal
DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	18
HEIGHT RELATIVE TO OBSERVER	Start 16 End ✓
DISTANCE FROM OBSERVER	Start 60' End ✓
DIRECTION FROM OBSERVER	Start N End ✓
DESCRIBE EMISSIONS	Start Lofting End ✓
EMISSION COLOR	Start Black End ✓
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start 2 ft above stack End ✓
DESCRIBE PLUME BACKGROUND	Start Sky End
BACKGROUND COLOR	Start Grey End ✓
SKY CONDITIONS	Start OVC End
WIND SPEED	Start 5 Kts End ✓
WIND DIRECTION	Start E End ✓
AMBIENT TEMP	Start 42 End ✓
WET BULB TEMP	
RH, percent	55

SOURCE LAYOUT SKETCH

Draw North Arrow

Stack with Plume
Sun
Wind



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
28 March	1452	1516

MIN \ SEC	0	15	30	45	COMMENTS
1	5	10	15	20	Burn cycle began 1451
2	20	20	25	15	
3	15	20	20	20	
4	25	25	25	30	
5	30	35	35	35	
6	40	40	40	40	
7	45	40	35	35	
8	40	45	40	40	
9	40	35	35	30	
10	40	40	40	35	
11	35	35	40	35	
12	40	40	30	30	
13	30	45	35	35	
14	30	30	30	15	
15	35	20	25	25	
16	25	20	20	20	
17	15	20	15	15	
18	15	15	10	10	
19	10	10	5	5	
20	5	5	5	5	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	Paul T. Scott
OBSERVER'S SIGNATURE	Paul T Scott
DATE	28 March 90
ORGANIZATION	AFOEHL/EQE
CERTIFIED BY	TACB
DATE	16 March 90

PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE K.I. Sawyer	PLANT Hospital Incinerator
DATE 28 Mar 90	SAMPLING TEAM AFOEHL
SOURCE TYPE AND MAKE Particulate	
SOURCE NUMBER	INSIDE STACK DIAMETER 12.25" Inches
RELATED CAPACITY	TYPE FUEL
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6 in Inches	
NUMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 8

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL *(Inches)*	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT *(Inches)*
6,5	0		
7.3	10		
8.4	15		
10.0	19		
14.3	20		
15.9	10		
17.0	3		
19.8	0		

OEHL FORM APR 78 15

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE	DATE
KI Sawyer	28 Mar 90

BOILER NUMBER: Hosp Incinerator

INSIDE STACK DIAMETER: 12.25 Inches

STATION PRESSURE: ~~[illegible]~~ 29.85 In Hg

STACK STATIC PRESSURE: -.05 In H20

SAMPLING TEAM: AFOEHL

TRAVERSE POINT NUMBER	VELOCITY HEAD, Vp IN H20	$\sqrt{V_p}$	STACK TEMPERATURE (°F)
11 1	.02		502
23 2	.08		645
27 3	.08		1012
32 4	.09		1397
31 5	.12		1444
31 6	.12		1455
35 7	.11		1428
35 8	.11		1442
	FPS = ~~3.0~~ ~~3.5~~ 30.0		
	T_s = 1,166		
		Q = .5047	
	~~1635~~		
AVERAGE			

OEHL FORM APR 78 16

APPENDIX E

Calibration Data

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POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number one Date 16 APR 90 Meter box number Nutech 2 Post Plant K.I. Sawyer

Barometric pressure, P_b = 29.195 in. Hg Dry gas meter number ______ Pretest Y 0.999

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d),[a] °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \dfrac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.95	10	10.11	75 76 535.5	79 83 541	75 77 536	538.50	13.03	~~15~~ 20	0.990	$\frac{10\,(29.195)\,(538.5)}{(10.11)(29.195 + 1.95/13.6)\,535.5}$
1.95	10	10.045	76 76 536	74 87 540.5	75 ~~77~~ 536	538.3	12.90	10	0.995	$\frac{10\,(29.195)\,(538.3)}{(10.045)(29.195 + 1.95/13.6)\,536}$
1.95	10	10.10	77 77 537	88 90 549	78 80 539	538	12.93 ~~12.90~~	10	0.985	$\frac{10\,(29.195)\,(538)}{(10.10)(29.195 + 1.95/13.6)\,538}$
									Y = 0.990	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

$y \pm 0.050$

$1.049 \leftarrow y \rightarrow 0.949$

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm 0.05Y$.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)   Scott/Vaughn

Test number one   Date 12 Dec 89   Meter box number Nutech 2   Plant ~~Pre Kelly H~~ Pre K.I. Sawyer, Port Kelly GTE

Barometric pressure, P_b = 29.350 in. Hg   Dry gas meter number N/A   Pretest Y Ø.999   ΔH@ = 1.969

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (Θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
.5	10	10.174	66 64 65	70 75 72.5	70 70 70.0	71.25	25.51	4.0	Ø.993	(10)(29.35)(531.25) / (10.174)(29.35+.0368)(525)
.5	10	10.225	64 65 64.5	75 78 76.5	70 73 71.5	74.0	25.52	4.0	Ø.992	(10)(29.35)(534) / (29.35+.0368)(10.225)(524.5)
.5	[illegible]	10.277	67 67 67	80 81 80.5	75 76 75.5	78.0	25.51	4.0	Ø.992	(10)(29.35)(538) / (29.35+.0368)(10.277)(527)
									Y = Ø.992	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y. .999 ± .04995   ⇒ Ø.941 ≤ y_{post} ≤ 1.049

P_b = Barometric pressure, in. Hg.

Θ = Time of calibration run, min.

Quality Assurance Handbook M4-2.4A

NOZZLE CALIBRATION DATA FORM

Date ____________ Calibrated by Scott

Nozzle identification number	Nozzle Diameter[a]			ΔD,[b] mm (in.)	D_{avg}[c]
	D_1, mm (in.)	D_2, mm (in.)	D_3, mm (in.)		
1	.50	.502	.501	.002	.501
2	.50	.500	.500	.001	0.5003

where:

$^{a}D_{1,2,3,}$ = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

b ΔD = maximum difference between any two diameters, mm (in.), $\Delta D \leq$(0.10 mm) 0.004 in.

c D_{avg} = average of D_1, D_2, and D_3.

TYPE S PITOT TUBE INSPECTION DATA FORM

#4A

Pitot tube assembly level? ___✓___ yes ________ no

Pitot tube openings damaged? ____ yes (explain below) ___✓___ no

α_1 = __0__ ° (<10°), α_2 = __1__ ° (<10°), β_1 = __0__ ° (<5°),
β_2 = __1__ ° (<5°)

γ = __0__ °, θ = __1__ °, A = __1.0__ ~~cm~~ (in.)

z = A sin γ = __0.0__ ~~cm~~ (in.); <0.32 cm (<1/8 in.),
w = A sin θ = __0.0175__ ~~cm~~ (in.); <.08 cm (<1/32 in.)
0.0313

P_A __0.5__ ~~cm~~ (in.) P_b __0.5__ ~~cm~~ (in.)

D_t = __0.375__ ~~cm~~ (in.)

Comments: CONSTRUCTED IAW 40 CFR 60, APP A, METH 2 FIG 2.2. ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? ______ yes ___✓___ no

Quality Assurance Handbook M2-1.7

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

NUTECH #2

Date 3 JAN 89 Thermocouple number INLET/OUTLET

Ambient temperature 26 °C Barometric pressure ______ in. Hg

Calibrator GARRISON SCOTT Reference: mercury-in-glass ASTM 63F

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] °C *
INLET				
-	HOT WATER BATH	43.5	43	.5
-	ROOM TEMP	26	26	0
OUTLET				
-	HOT WATER BATH	43.5	42	1
-	ROOM TEMP	26	26.5	.5

[a]Type of calibration system used.

[b] $$\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$$

Quality Assurance Handbook M5-2.5

* MUST BE WITHIN 3°C OF REFERENCE

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APPENDIX F

Acetone Blank Results and
Particulate Emissions Calculations

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RUN NUMBER
ONE RUN
METER BOX Y?
.9990 RUN
DELTA H?
2.0300 RUN
BAR PRESS ?
29.8500 RUN
METER VOL ?
44.4500 RUN
MTR TEMP F?
49.0000 RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
0.0000 RUN
STATIC HOH IN ?
-.0500 RUN
STACK TEMP.
758.0000 RUN
ML. WATER ?
42.8000 RUN

IMP. % HOH = 4.2

% HOH=4.2

% CO2?
0.0000 RUN
% OXYGEN?
20.3000 RUN
% CO ?
0.0000 RUN
MOL WT OTHER?
0.0000 RUN

MWd =28.81
MW WET=28.36

SQRT PSTS ?
9.3928 RUN
TIME MIN ?
80.0000 RUN
NOZZLE DIA ?
.5003 RUN
STK DIA INCH ?
12.2500 RUN

* VOL MTR STD = 46.185
STK PRES ABS = 29.85
VOL HOH GAS = 2.01
% MOISTURE = 4.18
MOL DRY GAS = 0.958
% NITROGEN = 79.70
MOL WT DRY = 28.81
MOL WT WET = 28.36
VELOCITY FPS = 23.18
STACK AREA = 0.82
STACK ACFM = 1,139.
* STACK DSCFM = 472.
% ISOKINETIC = 73.41

RUN NUMBER
TWO RUN
METER BOX Y?
.9990 RUN
DELTA H?
1.9000 RUN
BAR PRESS ?
29.8500 RUN
METER VOL ?
49.3720 RUN
MTR TEMP F? [illegible]
58.0000 RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
0.0000 RUN
STATIC HOH IN ?
-.0500 RUN
STACK TEMP.
782.0000 RUN
ML. WATER ?
61.1000 RUN

IMP. % HOH = 5.4

% HOH=5.4

% CO2?
7.7000 RUN
% OXYGEN?
10.4000 RUN
% CO ?
0.0000 RUN
MOL WT OTHER?
0.0000 RUN

MWd =29.65
MW WET=29.02

SQRT PSTS ?
9.3086 RUN
TIME MIN ?
64.0000 RUN
NOZZLE DIA ?
.5003 RUN
STK DIA INCH ?
12.2500 RUN

* VOL MTR STD = 50.392
STK PRES ABS = 29.85
VOL HOH GAS = 2.88
% MOISTURE = 5.40
MOL DRY GAS = 0.946
% NITROGEN = 81.90
MOL WT DRY = 29.65
MOL WT WET = 29.02
VELOCITY FPS = 22.71
STACK AREA = 0.82
STACK ACFM = 1,115.
* STACK DSCFM = 447.
% ISOKINETIC = 105.55

XROM "MASSFLO"

RUN NUMBER
ONE RUN

VOL MTR STD ?
46.1850 RUN
STACK DSCFM ?
472.0000 RUN
FRONT 1/2 MG ?
42.2000 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 0.0141
F MG/MMM = 32.2670
F LB/HR = 0.0570
F KG/HR = 0.0259

XROM "MASSFLO"

RUN NUMBER
TWO RUN

VOL MTR STD ?
50.3920 RUN
STACK DSCFM ?
447.0000 RUN
FRONT 1/2 MG ?
184.0000 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 0.0563
F MG/MMM = 128.9446
F LB/HR = 0.2159
F KG/HR = 0.0979

BLANK ANALYTICAL DATA FORM

Plant K. I. Sawyer AFB

Sample location Hospital Incinerator

Relative humidity ______

Liquid level marked and container sealed ✓

Density of acetone (ρ_a) 0.785 g/ml

Blank volume (V_a) 200 ml

Date and time of wt 21 May 90 1600 hr Gross wt 105261.4 mg

Date and time of wt 22 May 90 0745 hr Gross wt 105261.2 mg

Average gross wt 105261.3 mg

Tare wt 105260.3 mg

Weight of blank (m_{ab}) 1.0 mg

$$C_a = \frac{m_{ab}}{V_a \rho_a} = \frac{(1.0)}{(200)\ (0.785)} = 0.0064 \text{ mg/g}$$

Note: In no case should a blank residue greater than 0.01 mg/g (or 0.001% of the blank weight) be subtracted from the sample weight.

Filters Filter number ______

Date and time of wt ______ Gross wt ______ mg

Date and time of wt ______ Gross wt ______ mg

Average gross wt ______ mg

Tare wt ______ mg

Difference wt ______ mg

Note: Average difference must be less than ±5 mg or 2% of total sample weight whichever is greater.

Remarks ______

Signature of analyst Robert J. O'Brien

Signature of reviewer ______

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K. I. Sawyer Run # 1

$$\%EA = \frac{\%O_2 - 0.5\%CO}{0.264\ \%N_2 - [\%O_2 - 0.5\%CO]}$$ $CO \approx \cancel{0}$

$$= \frac{20.3}{(.264)(79.1) - 20.3} = 34.8558$$

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(29.85 \text{ in Hg})(1{,}139\ ft^3/min \times \frac{60 min}{hr})(528\ °R)}{(29.92 \text{ in Hg})(460 + 758)} = 29{,}555.9113\ ft^3/hr$$

$$(29{,}555.9113\ ft^3/hr)(.035312\ l/ft^3)\left(\frac{lb mole}{22.4 l}\right)(29.02\ lb/lb mole) = 1{,}352.0460\ lbs/hr$$

$$\frac{0.057\ lbs/hr}{x} = \frac{1{,}352.0460\ lbs/hr}{1{,}000}$$ $x = 0.0422$ lbs/1,000 lbs of exhaust gas

Concentration corrected to 50% excess Air $= (0.0422)\left(\frac{100 + 34.8558}{150}\right) = 0.0379$ lbs/1,000 lbs of exhaust gas corrected to 50% excess air

Run 1 & 2 Ave = 0.075

L.I Sawyer Run #2

Section 3.2.6 QA Manual

$$\% EA = \frac{\% O_2 - 0.5\% CO}{0.264\% N_2 - [\% O_2 - 0.5\% CO]}$$

$CO \approx \emptyset$

$$= \frac{\% O_2}{0.264\% N_2 - \% O_2} = \frac{10.4}{0.264(79.1) - 10.4} = 0.9921$$

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(29.85 \text{ in Hg})(66,900 \text{ ft}^3/\text{hr})(528\,°R)}{(29.92 \text{ in Hg})(460 + 782\,°F)} = 28,374.0409 \text{ ft}^3/\text{hr}$$

$$(28,374.0409 \text{ ft}^3/\text{hr})(.035312\ \ell/\text{ft}^3)\left(\frac{\text{lb mole}}{22.4\ \ell}\right)(29.02 \text{ lb}/\text{lb-mole}) = 1,297.9809 \text{ lb}/\text{hr}$$

$$\frac{0.2159 \text{ lb}/\text{hr}}{x} = \frac{1,297.9809}{1,000} \qquad x = 0.1663 \text{ lbs}/1,000 \text{ pounds of exhaust gas}$$

Concentration corrected to 50% Excess Air

$$= \left(\frac{.1663 \text{ lbs}}{1,000 \text{ lbs of exhaust gas}}\right)\left(\frac{100 + .9921}{150}\right) = 0.1120 \text{ lbs}/1000 \text{ lbs exhaust ga.}$$

APPENDIX G

Air Dispersion Model

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1 PTPLU-2.0 (VERSION 86196)
AN AIR QUALITY DISPERSION MODEL IN
SECTION 3. NON-GUIDELINE MODELS.
IN UNAMAP (VERSION 6) JUL 86
SOURCE: UNAMAP FILE ON EPAS UNIVAC AT RTP, NC.

>>>INPUT PARAMETERS<<<

*** TITLE*** KI Sawyer AFB - Hospital Incinerator

OPTIONS
IF = 1, USE OPTION
IF = 0, IGNORE OPTION
IOPT(1) = 0 (GRAD PLUME RISE)
IOPT(2) = 1 (STACK DOWNWASH)
IOPT(3) = 1 (BUOY. INDUCED DISP.)
IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)
MUOR = 1(1 = URBAN, 2 = RURAL)

METEOROLOGY
AMBIENT AIR TEMPERATURE = 277.00 (K)
MIXING HEIGHT = 1500.00 (M)
ANEMOMETER HEIGHT = 10.00 (M)
WIND PROFILE EXPONENTS = A:0.15, B:0.15, C:0.20 D:0.25, E:0.30, F:0.30

SOURCE
EMISSION RATE = 0.0072 (G/SEC)
STACK HEIGHT = 1.47 (M)
EXIT TEMP. = 676.33 (K)
EXIT VELOCITY = 6.92 (M/SEC)
STACK DIAM. = 0.311 (M)

0***RECEPTOR HEIGHT*** = 1.00 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 0.53 (M**3/SEC) BUOYANCY FLUX PARAMETER = 0.97 (M**4/SEC**3)

KI Sawyer AFB - Hospital Incinerator

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	1.4935E-06	0.112	43.3	0.38	1.1617E-06	0.146	57.3
1	0.80	2.2427E-06	0.072	27.6	0.60	1.7505E-06	0.094	36.3
1	1.00	2.7086E-06	0.059	22.4	0.75	2.1223E-06	0.077	29.4
1	1.50	3.7514E-06	0.042	15.4	1.13	2.9873E-06	0.053	20.1
1	2.00	4.6516E-06	0.033	11.9	1.50	3.7516E-06	0.042	15.4
1	2.50	5.4463E-06	0.027	9.8	1.88	4.4369E-06	0.035	12.6
1	3.00	6.1529E-06	0.024	8.4	2.25	5.0621E-06	0.030	10.8

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	1.4935E-06	0.112	43.3	0.38	1.1617E-06	0.146	57.3
2	0.80	2.2427E-06	0.072	27.6	0.60	1.7505E-06	0.094	36.3
2	1.00	2.7086E-06	0.059	22.4	0.75	2.1223E-06	0.077	29.4
2	1.50	3.7514E-06	0.042	15.4	1.13	2.9873E-06	0.053	20.1
2	2.00	4.6516E-06	0.033	11.9	1.50	3.7516E-06	0.042	15.4
2	2.50	5.4463E-06	0.027	9.8	1.88	4.4369E-06	0.035	12.6
2	3.00	6.1529E-06	0.024	8.4	2.25	5.0621E-06	0.030	10.8
2	4.00	7.3486E-06	0.019	6.7	3.00	6.1532E-06	0.024	8.4
2	5.00	8.5374E-06	0.015	5.6	3.75	7.0747E-06	0.020	7.0

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	5.5093E-06	0.040	11.9	1.36	4.0770E-06	0.055	16.8
3	2.50	6.4835E-06	0.033	9.8	1.70	4.8750E-06	0.045	13.7
3	3.00	7.3463E-06	0.028	8.4	2.04	5.6015E-06	0.039	11.7
3	4.00	8.8055E-06	0.022	6.7	2.73	6.8857E-06	0.031	9.1
3	5.00	1.0250E-05	0.018	5.6	3.41	7.9794E-06	0.026	7.6

3	7.00	0.0000E+00	0.000	4.1	4.77	9.8426E-06	0.019	5.8
3	10.00	0.0000E+00	0.000	3.1	6.81	0.0000E+00	0.000	4.2
3	12.00	0.0000E+00	0.000	2.6	8.18	0.0000E+00	0.000	3.6
3	15.00	0.0000E+00	0.000	2.2	10.22	0.0000E+00	0.000	3.0

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	1.6165E-06	0.206	43.3	0.31	1.0322E-06	0.334	69.0
4	0.80	2.4771E-06	0.130	27.6	0.50	1.6026E-06	0.208	43.7
4	1.00	3.0134E-06	0.105	22.4	0.62	1.9669E-06	0.167	35.3
4	1.50	4.2370E-06	0.072	15.4	0.93	2.8257E-06	0.113	24.0
4	2.00	5.3136E-06	0.056	11.9	1.24	3.6166E-06	0.086	18.4
4	2.50	6.2607E-06	0.046	9.8	1.55	4.3463E-06	0.070	15.0
4	3.00	7.0889E-06	0.040	8.4	1.86	5.0204E-06	0.059	12.7
4	4.00	8.4886E-06	0.032	6.7	2.48	6.2191E-06	0.047	9.9
4	5.00	9.8799E-06	0.026	5.6	3.10	7.2373E-06	0.039	8.2
4	7.00	1.3264E-05	0.018	4.1	4.33	8.8931E-06	0.030	6.3
4	10.00	0.0000E+00	0.000	3.1	6.19	1.1910E-05	0.021	4.6
4	12.00	0.0000E+00	0.000	2.6	7.43	1.4004E-05	0.017	3.9
4	15.00	0.0000E+00	0.000	2.2	9.29	0.0000E+00	0.000	3.3
4	20.00	0.0000E+00	0.000	1.8	12.38	0.0000E+00	0.000	2.6

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	9.7677E-07	0.216	24.4	1.13	1.1888E-06	0.264	29.2
5	2.50	9.0349E-07	0.200	22.7	1.41	1.1024E-06	0.244	27.2
5	3.00	8.3745E-07	0.197	21.5	1.69	1.0358E-06	0.229	25.7
5	4.00	7.4449E-07	0.184	19.7	2.25	9.3744E-07	0.207	23.5
5	5.00	6.8751E-07	0.172	18.3	2.81	8.6065E-07	0.200	21.9

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	1.4030E-06	0.179	20.5	1.13	1.7186E-06	0.217	24.5
6	2.50	1.2944E-06	0.166	19.1	1.41	1.5898E-06	0.201	22.8
6	3.00	1.2036E-06	0.162	18.1	1.69	1.4906E-06	0.189	21.6
6	4.00	1.0656E-06	0.152	16.6	2.25	1.3447E-06	0.172	19.7
6	5.00	9.8236E-07	0.142	15.4	2.81	1.2381E-06	0.164	18.4

0 (1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

0 (2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

0 (3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

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